VLBI 2010's Role in an Integrated Geodetic Site

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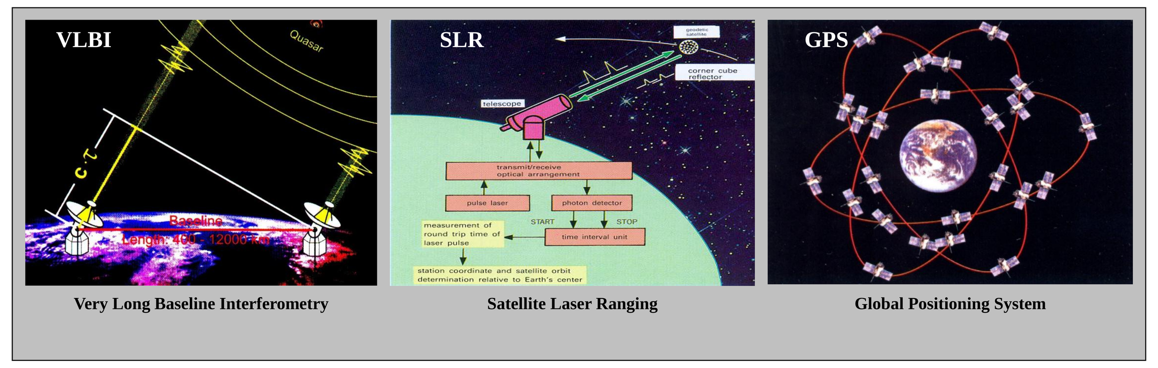
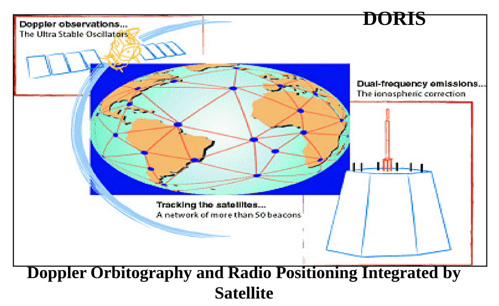
Background

Space geodetic systems provide the measurements that are needed to define and maintain the International Terrestrial Reference Frame.

- The ITRF is realized through a combination of observations from globally distributed SLR, VLBI, GNSS and DORIS systems.
- NASA has contributed SLR, VLBI and GNSS systems to the global network since the Crustal Dynamics Project in the 1980s.

The International Terrestrial Reference Frame (ITRF)

Provides the stable coordinate system that allows us to measure change (link measurements) over space, time and evolving technologies.

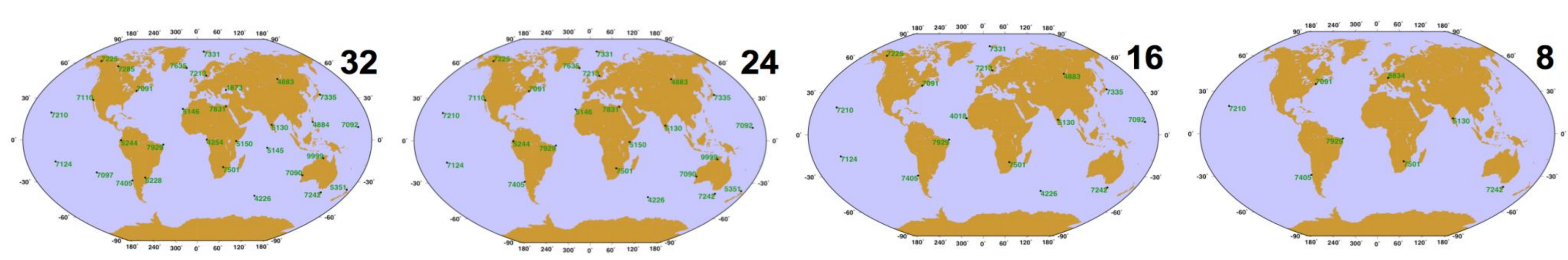
- An accurate, stable set of station positions and velocities.
- Foundation for virtually all space-based and ground based metric observations of the Earth.
- Established and maintained by the global geodetic space networks.
- Network measurements must be precise, continuous and worldwide.
- Must be robust, reliable and geographically distributed.
  - Proper density over continents and oceans
  - Interconnected by co-location of different observing techniques.

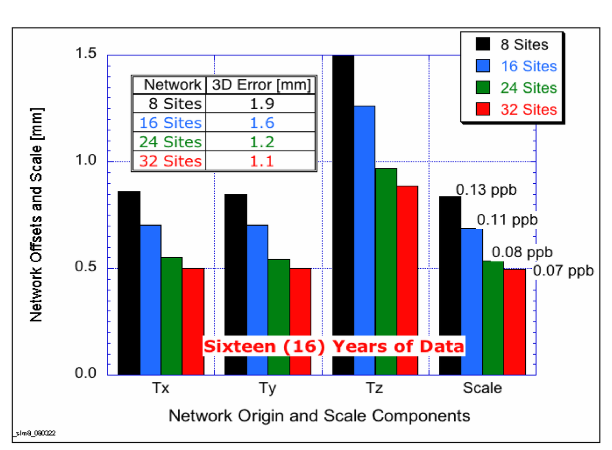
Requirements for the ITRF have increased dramatically since the 1980's.

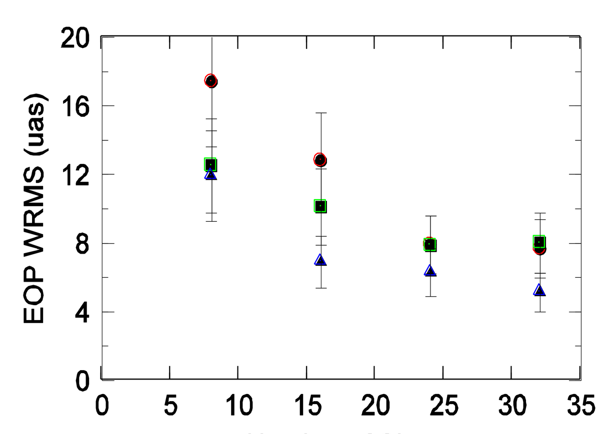
- Most stringent requirement comes from sea-level studies:
  - "Accuracy of 1 mm, and stability of 0.1 mm/yr"
  - **This is a factor of 10-20 beyond current capability.**

Simulated Integrated Geodetic Station Network

Simulation studies indicate that to achieve this level of stability and accuracy, 24-32 globally distributed integrated geodetic stations are needed with each station having several techniques.

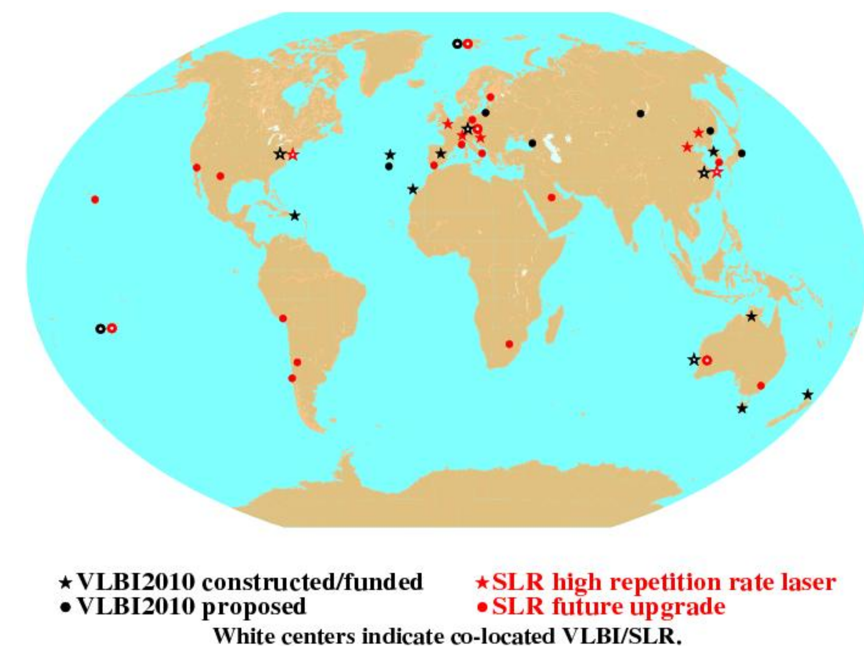






E. Pavlis (2009)

Prospective Global VLBI and SLR Network



Sites with definite or possible upgrades of VLBI and SLR systems.

Note the continuing sparseness in the Southern Hemisphere.

NASA Prototype Station at GGAO

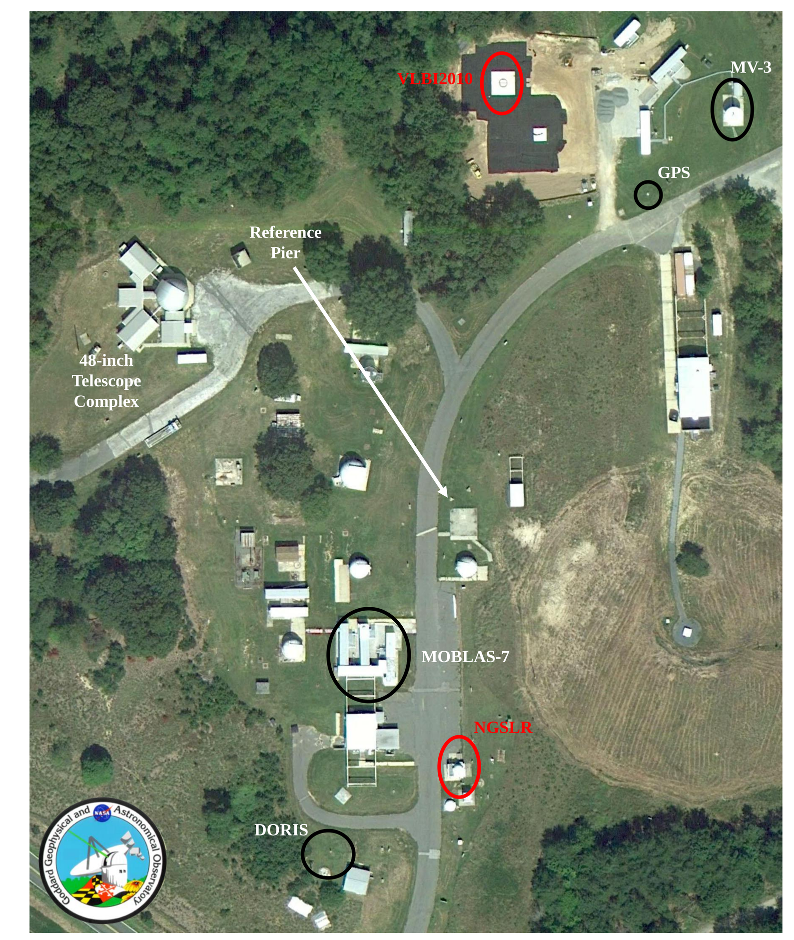
Goddard Geophysical &Astronomical Observatory has four techniques on site:

- Legacy SLR, VLBI, GPS, DORIS
- NGSLR semi-operational
- VLBI2010 antenna installed and being equipped

GGAO will be the location for the prototype next generation multi-technique station as developed by NASA.

Next steps:

- Network simulations to determine operational and technical tradeoffs based on LAGEOS, GNSS, VLBI.
- Complete prototypes of SLR and VLBI instruments.
- Implement automated survey system to measure inter-technique vectors for co-location.
- Develop generalized station layout considering RFI and operational constraints.
- Begin site evaluation for network station development.



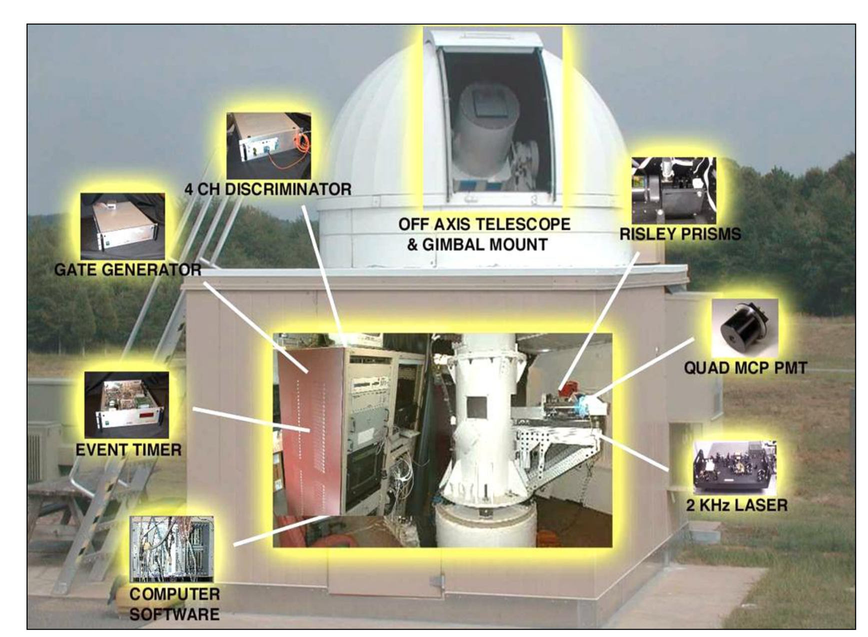
Next Generation SLR at GGAO

Key characteristics of NGSLR:

- A low pulse energy, high rep rate, single photon detection laser ranging system capable of tracking retro-reflector equipped satellites up to 20,000 km.
- Daylight and night-time tracking.
- Reduced ocular, chemical and electrical hazards.
- Automated tracking.

In place:

- Successfully ranges to LEO and GNSS satellites.
- Agrees +/- 2 cm with network standard MOBLAS7.
- GSFC-developed variable mJ laser capable of both eye-safe and daylight GNSS tracking.



VLBI2010 at GGAO

Key characteristics of VLBI2010:

- Fast, small antennas.
- Unattended operations.
- More observations for troposphere and geometry.
- Broadband feed for multi-band observable.
- Higher speed recording for increased sensitivity.
- Modern digital backend electronics.

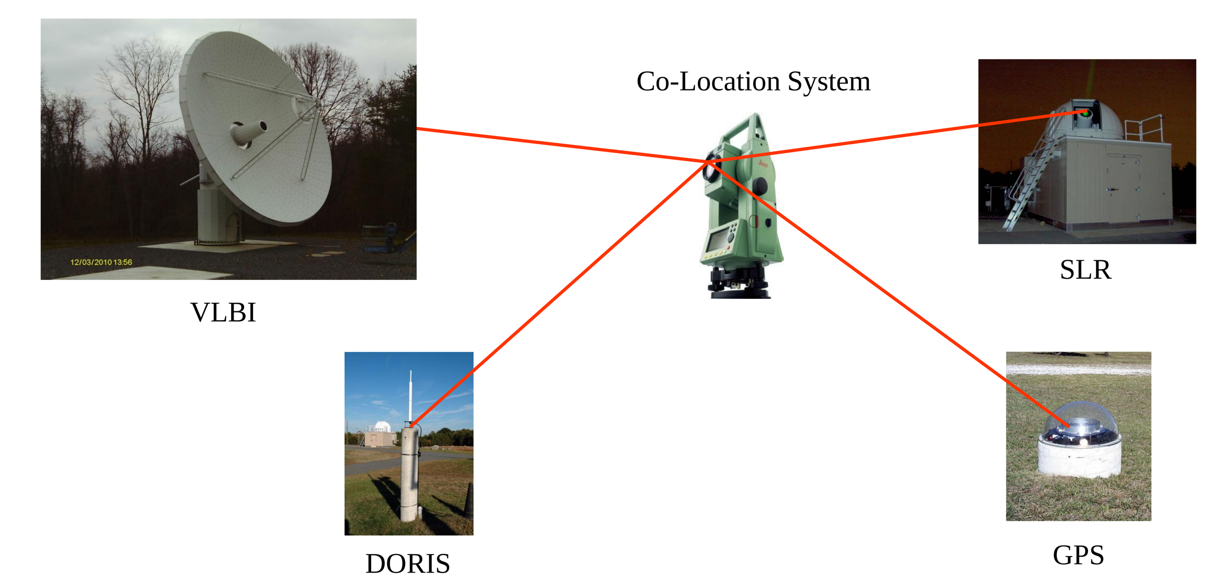
In place:

- 12-m Patriot antenna – 6 deg/sec azimuth rate.
- Proof-of-concept cryogenic COTS broadband feed
- DBE-1 (Digital Back End)
- Mark 5B Recorder
- UpDown Convertor (UDC) for flexible RF placement

Next months:

- Broadband Eleven Feed
- RDBE
- Mark 5C

Co-location Monitoring at GGAO



Key characteristics:

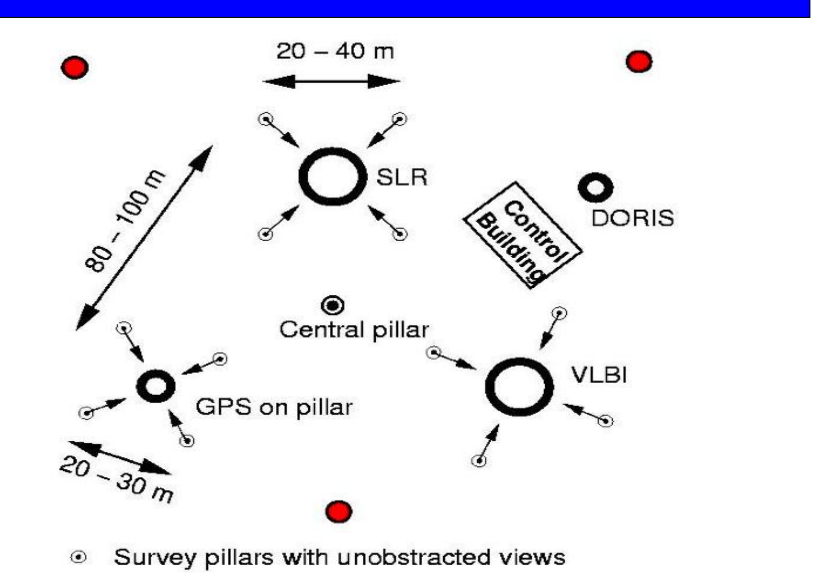
- System needs to be simple enough for site personnel to set up and operate.
- Automatic, rapid, computer-driven.
- Done regularly: daily or weekly.

Demonstrated:

- Automated VLBI reference point determination using Leica TCA2003 robotic total station.

Idealized Station Layout

Idealized configuration of space geodetic instruments for new integrated station. Considerations for blockage and interference mitigation. Survey monuments should be optimally placed to measure and monitor local ties.



Future

Awaiting NASA approval of Space Geodesy Project for completion of 2 -yr development plan.

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